OPERATION AND MAINTENANCE MANUAL

4S17
compressor

HEALTH AND SAFETY AT WORK ACT 1974

Where we supply a complete factory built air compressor set, we ensure that measures are taken to comply with our responsibilities in respect of the Act.

In addition, it is essential that the operator is aware of the inherent hazards associated with the use of compressed air particularly in such applications as breathing or food or drink processing where specialist filtration is essential.

Also when we supply a bare air compressor unit certain responsibilities under the Act will pass to the customer and will include that:

1. All drives and moving parts are fully guarded.
2. Our recommendations on operating conditions including maximum pressure and speed are not exceeded.
3. Any air receiver or pressure vessel used in conjunction with the compressor is constructed to be suitable for the working pressure of the unit and has been tested to any relevant standard.
4. Interconnecting pipework is adequate in strength.
5. A suitable safety valve, correctly situated, and a pressure control device are included in the installation.

If in doubt, ask our advice.

W A R N I N G

Misuse of compressed air can be dangerous. It cannot be stressed too strongly the importance of taking every precaution in the use of compressed air and its associated equipment.

NEVER Start any maintenance or servicing work on a compressor or compressed air system without ensuring entire system is fully depressurised. Failure to observe this precaution may result in serious injury.

NEVER Tighten a pipe union that is under pressure.

NEVER Adjust a safety valve beyond the manufacturer's setting. A safety valve is fitted to prevent over pressurising the air receiver and over loading the air compressor. To interfere with its setting could result in serious damage or injury.

NEVER Carry out any work whatsoever unless the electric supply has been switched off at the mains.

NEVER Pass in front of a receiver valve when compressed air is being released. This is particularly dangerous as any particles of iron scale in the air stream could become imbedded in the skin.

NEVER Attempt to straighten badly bent pipes or re-use damaged union fittings.

NEVER Use worn or damaged components that particularly rely on threads for security i.e. nuts, bolts, nipples and drain taps etc.

NEVER Tamper with a live electrical circuit. If in doubt call upon the services of a qualified electrician.

REMEMBER Before opening a manual drain or vent valve, always ensure that valve exhaust port is not blocked or plugged. Remove any red plastic plugs that may be present.

Determine in which direction air will exhaust through port to atmosphere and avoid positioning any part of the body in the direction of flow.

ALWAYS open a drain or vent valve SLOWLY and with caution. NEVER open a drain or vent valve rapidly.

REMEMBER To firmly secure all externally fitted installation pipe work. This will prevent undue vibration and possible fracture under pressure.

REMEMBER To have your compressors installed in accordance with your local Electrical Authority requirements. A piece of three core flex and a three pin plug does not constitute an installation.

REMEMBER COMPRESSED AIR CAN KILL - TREAT IT WITH RESPECT

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Section 1 – Technical Description

1.1 Technical Data

Compressor Type	4S17
Number of Compression Stages	Four
Operating Pressure	Up to 414 Bar (6000 lbf/in^2)
Operating Speed	1750 rpm
Displacement	29.3 m^3/Hr (17.26 cfm @ 1750 rpm)
Average Charging Rate	23.8 m^3/Hr (14.0 cfm)
Power Requirement	7.5 kW (10.0 HP)
Cooling	Air
1st Stage Pressure	5.4 bar (78 lbf/in^2)
2nd Stage Pressure	30.7 bar (445 lbf/in^2)
3rd Stage Pressure	84.1 bar (1220 lbf/in^2)
Discharge Pressure	414 bar (6000 lbf/in^2)
Safety Valve Settings:	
1st Stage	10.3 bar (150 lbf/in^2)
2nd Stage	44.8 bar (650 lbf/in^2)
3rd Stage	96.5 bar (1400 lbf/in^2)
Final Stage	431 bar (6250 lbf/in^2)
Lubrication System	Controlled Splash
Recommended Oil	Anderol 555
Crankcase Oil Capacity	1.2 litres (2.5 Pints)
Overall Dimensions:	
Length	570 mm (22.4 inches)
Width	450 mm (17.7 inches)
Height	505 mm (19.9 inches)
Unit Weight (Dry)	72 kg (158 lb.)

1.2 Introduction

The model 4S17 Compressor is designed to compress air to a pressure of 414 Bar (6000 lbf/in^2). The machine is a twin Vee-Form, double-acting, reciprocating unit, having three cylinders giving four stages of compression. A double- grooved flywheel carries a segmented fan assembly for cooling the cylinders, intercoolers and aftercooler. A replaceable air intake filter is fitted in the inlet duct. Factory set safety valves are fitted in all stages and air from the third stage is filtered by a sintered bronze element. Lubrication is by a controlled splash arrangement.

Nominal ambient operating temperature for the pump is between -5 Celsius and +65 Celsius

The compressor is used for example, in Eagle Compressors charging sets, but may also have wide applications in various other installations. Machines may be driven by petrol, diesel or electric motors, to suit site requirements.

1.3 Principle Of Operation

Air is taken from the atmosphere via a replaceable air filter into the low-pressure cylinder and is compressed to 5.4 Bar (78 lbf/in^2). The compressed air passes through a coiled finned pipe assembly for cooling and the safety valve in the line is set at 10.3 Bar (150 lbf/in^2).

The double-acting cylinder then compresses the air to 30.7 Bar (445 lbf/in^2). A coiled pipe assembly is provided for cooling and a second stage safety valve is set at 44.8 Bar (650 lbf/in^2).

The third stage cylinder compresses the air to 84.1 Bar (1220 lbf/in^2). The safety valve is set at 96.5 Bar (1400 lbf/in^2). A sintered bronze filter is provided in the line for removing impurities from the air and a third coiled pipe assembly is provided for cooling. Moisture separation is carried out by two vertically mounted separators, each mounted adjacent to a coiled pipe assembly intercooler and fitted with a moisture draining point.

The fourth stage cylinder compresses the air to a maximum pressure of 414 Bar (6000 lbf/in^2). The safety valve is set at 431 Bar (6250 lbf/in^2) or at 10% above the working pressure if working pressure is below 414 Bar. A further coiled pipe assembly acts as an aftercooler and is mounted underneath the plinth.

The unit is belt driven via a flywheel pulley which turns the crankshaft and cooling fan. The intercoolers and aftercooler coiled pipe assemblies are mounted externally in the airstream provided by the cooling fan.

Lubrication is by a combination of controlled splash and crankcase-to-inlet differential pressure. Internal lubrication is created by splash from dippers on both connecting rods which pass through the oil in the crankcase. The differential pressure between the crankcase and inlet depression causes oil vapours to rise up the external breather pipe into the inlet and thus lubricate the first stage valves and cylinder. A controlled level of oil carry-over lubricates the upper portion of the remaining cylinders.

1.4 Mechanical Construction

The crankcase is manufactured from high quality aluminium alloy and is fitted with a detachable inspection cover, a combined filler and dipstick plug, a removable magnetic drain plug and an eyebolt for lifting purposes.

The ball bearing mounted crankshaft is of spheroidal graphite cast iron and connecting rods forged from high tensile steel. The first, second and third stage pistons are aluminium and the fourth stage piston is of high quality steel.

The low-pressure cylinder head is of aluminium alloy and the high-pressure cylinder head is of a spheroidal graphite cast iron. The second and third stage valves are automatic spring-controlled plate types with a one-piece valve retainer. The first stage valve assembly is a reed valve which is located between the first stage cylinder head and the cylinder. The fourth stage valve components are held in position under the fourth stage cylinder head.

The fan assembly is mounted with the flywheel on the crankshaft. Cooling between the first and second compression stages is achieved by the finned pipe coiled directly behind the flywheel. The intercooler coiled pipe assemblies are mounted on either side of the compressor with the aftercooler located beneath the compressor unit.

The two moisture separators are vertically mounted and each is fitted with a moisture draining point

Figure 1.1 – Compressor Model 4S17

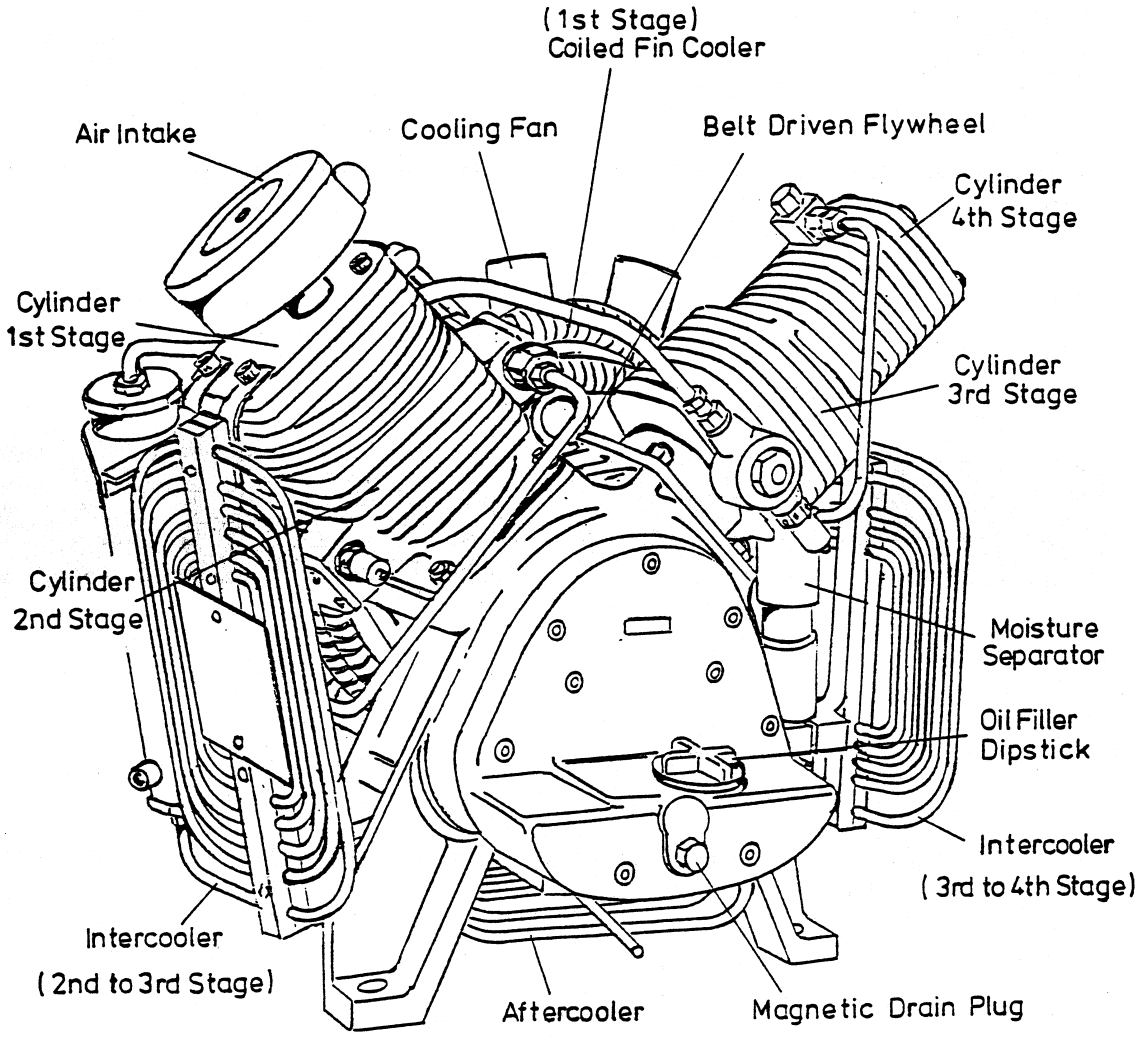
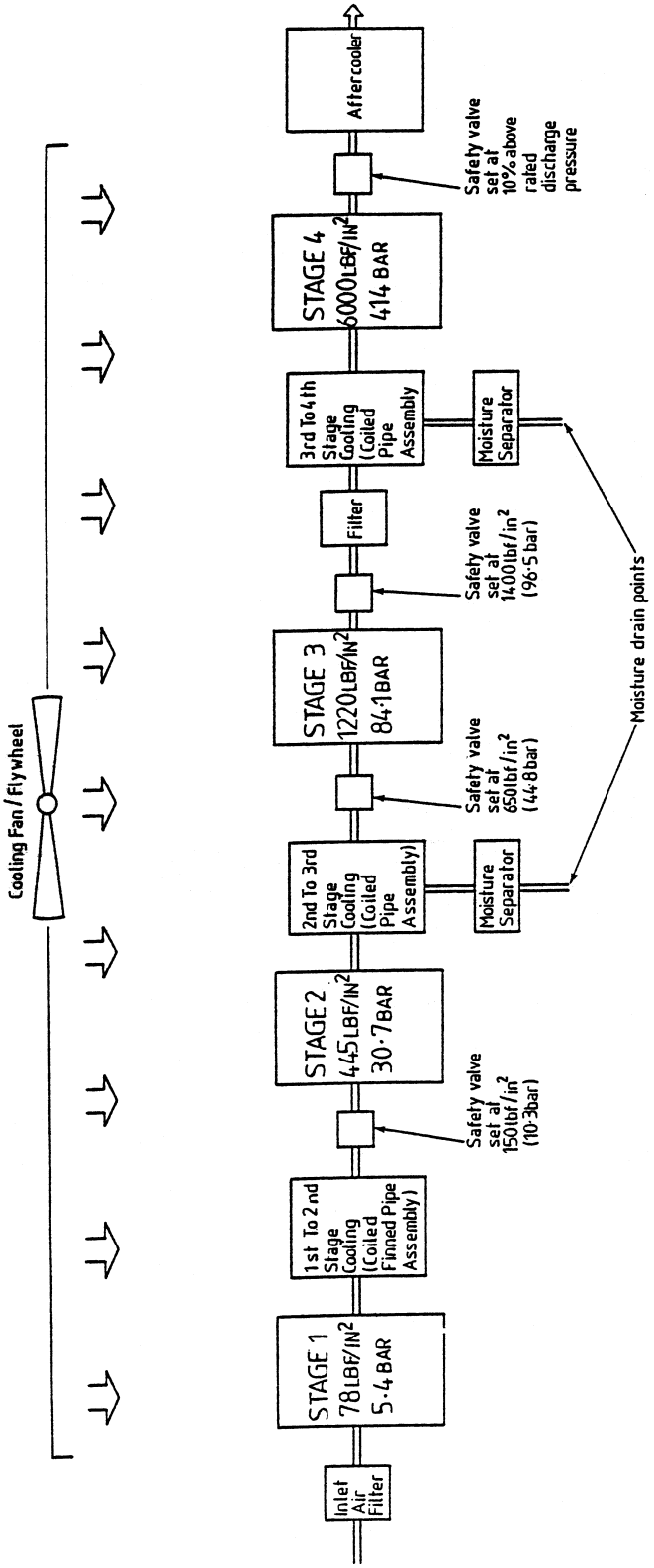


Figure 1.2 – Principle Of Operation



Section 2 – Installation and Storage

Additional Information – Initial Starting Procedure

On despatch, compressors are either inhibited for 6 months with oil drained or supplied with a full charge of oil in the sump, as indicated on label attached to compressor.

On receipt of compressor, examine label to determine which condition applies. If compressor is drained of oil, fill to the correct level with the correct grade of lubricant. If compressor is filled with oil, check oil level and replenish if necessary.

IMPORTANT:

Compressors supplied with oil in sump area are filled with Anderol 555. This is synthetic oil and must NOT be mixed with mineral oil under any circumstances.

A compressor supplied with Anderol 555 in the sump must be operated with Anderol 555.

2.1 Receipt

If the compressor is packed in a wooden crate, it may be manoeuvred on site with a suitable forklift truck. Remove the packing crate top on receipt, check the contents with respect to the packing note and immediately report any shortages, damage or defects to the manufacturer.

A single eyebolt is fitted on top of the unit for lifting purposes.

CAUTION:

Use eyebolt to lift compressor only. Do not use eyebolt to lift if the compressor is attached to its bedplate or any other associated equipment.

2.2 Location

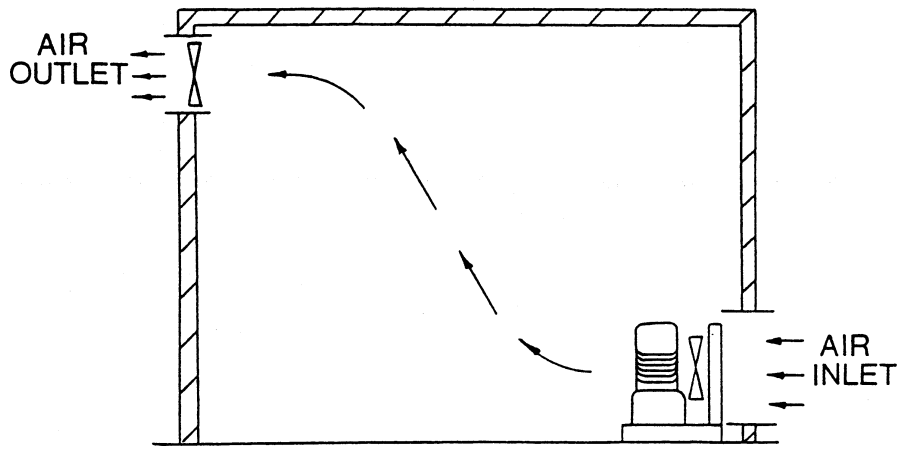
The site should have access to clean, cool atmospheric air, free from fumes, toxic gases, factory odours, dust and dampness.

Allow at least 0.75 M (30”) around the machine to enable all normal maintenance work, including major repairs, to be carried out.

If a compressor is to be used for charging systems which supply air for breathing, it is essential that a reputable air purifying system is incorporated after the compressor.

A final stage moisture separator and relief valve is recommended to be incorporated into the system where the compressor produces a high-pressure air outlet.

As a general rule, air cooled compressors operating in a room or confined space should be installed to prevent cooling air recirculation and a build up of the ambient temperature within the room. Ideally, the cooling fan should be positioned close to an external intake duct and an extractor fan positioned in the ceiling or upper part of the confined space, as shown in the diagram. The extractor fan flow rate should be at least equal to the compressor cooling fan flow rate.



Compressor room air flow

Where two machines are installed in the same room, they should be positioned so that hot air from one machine is not induced into the other machine. Do not install machines back to back as this will effect the compressor fan flow rate. If in doubt, ask our advice

2.3 Electrical

It is strongly recommended that the necessary electrical installation work is carried out by a competent electrician or electrical engineer.

When a compressor is intended to be driven by an electric motor, the associated motor and switchgear provided are wound and set for the voltages specified on the motor reference plate. Any attempt to operate the equipment on other supply voltages will inevitably lead to damage and premature breakdown.

A combined isolator switch/fusebox should be provided and wired to the starter switch. The wiring must be capable of carrying the full starting current and the voltage drop must not exceed 5% of the rated supply voltage of the compressor. The fuses must not be less than THREE times

the full load current of the motor at up to 10 amps, and TWICE the full load current over 10 amps.

The direction of rotation of the compressor is anti- clockwise when viewed from the drive end. When driven by a three-phase motor, the direction of rotation (if seen to be incorrect) may be reversed by interchanging any two mains supply leads.

CAUTION:

If the compressor is run in the reverse direction, it may be starved of oil. Also, cylinders and interstage cooling pipes will not be effectively cooled.

2.4 Setting Up Procedure

To set up the unit before operation:

1) Ensure that the unit is securely bolted down in position on site.

2) Visually check the unit for any signs of damage and of possible obstructions to moving parts. Check that all moving parts such as pulleys and drive belts are properly guarded.

3) The drive motor should be mounted adjacent to the compressor with the belt pulleys in line and adjusted horizontally to provide the correct belt tension. Check the tension of the belts. If necessary, tighten the belts by releasing the drive motor hold-down bolts and moving the motor horizontally until the belts are at the right tension. For a quick, approximate check of belt tension, use a finger and thumb grip on the centre of a belt and twist the belt. For a correctly tensioned belt, the twist should be a quarter of a turn (90°).

4) Check that the air intake filter is correctly fitted and is in good condition.

5) Fill the sump with the recommended oil, as listed in the Technical Data Section 1.1.

2.5 Storage

The following recommendations are offered if compressors are not to be installed immediately or if they are to be taken out of service for a time. The recommendations are based on temperate climatic conditions and the periods specified may be superseded by alternatives as appropriate for the prevailing conditions.

The principal objective when storing the compressor for either short or long periods is to remove all traces of moisture from the machine and to replace the normal lubricating oil with rust-preventing inhibiting oil. The only inhibiting oil currently recommended by Beliss and Morcom is Shell Ensis 158.

a) Shut-Down

On manually operated compressors, the unit should be run for two to three minutes with the condensate drains open. This purges the system of moisture before shutdown. If the unit is likely to be shutdown for more than four weeks, it is advisable to carry out the following short-term inhibiting procedure.

b) Short-Term Inhibiting

The following recommendations are offered for storing the machine for short-term periods of up to six months:

1) Drain off the lubricating oil whilst still warm.

2) Fill the crankcase to the maximum level with Shell Ensis 158 rust inhibiting oil.

3) Run the compressor off-load for 20 to 30 minutes with the separator drains open.

4) Stop the compressor and remove the air intake filter. Inject 3 to 4 cc's of Shell Ensis 158 into the air intake port and refit the air filter. This is to ensure protection of the valves and upper cylinder components.

5) Run the compressor for a further minute.

6) Drain off the inhibiting oil from the crankcase.

7) If the compressor is to be removed from the installation, seal all openings with plugs.

8) Remove the sintered bronze filter element. Access to the filter is gained by unscrewing the brass cap and removing the spring from the filter. Wash the filter in white spirit or carbon tetrachloride, dry thoroughly with a low-pressure air jet and reassemble.

CAUTION:

Do not turn the crankshaft after removing the inhibiting oil or before carrying out the start-up procedure outlined in 2.5.d.

c) Long-Term Inheriting

The following recommendations are offered when storing the machine for long-term periods of over six months:

1) Carry out the recommended shutdown procedure as outlined in Section 2.5.a. but run the compressor on a supply of dry air.

2) Carry out the recommended short-term inhibiting procedure as outlined in Section 2.5. b.

3) Remove the fourth stage piston. Coat the piston with a suitable long-term protective such as Shell Ensis 256 (cold dip) or Shell Ensis 352 (hot dip) in accordance with the supplier's recommendations. Store the piston separately.

4) Clean all fourth stage valve parts and cylinder bore and coat with Shell Ensis 158. Refit and replace the cylinder head.

5) Place the complete compressor in a suitable long-term storage container together with a suitable desiccant such as silica gel. Ensure that a humidity indicator is clearly visible for regular inspections.

d) Start-Up After Short-Term Inhibiting

To prepare the compressor for operation after a short-term period of inhibiting:

1) Remove all plugs from openings.

2) Reconnect the compressor into the overall installation.

3) Refill the crankcase with lubricating oil as recommended in the Technical Data Section 1.1.

4) Run the compressor off-load for 15 minutes to circulate the oil.

CAUTION:

Take precautions to ensure that other equipment in the system is not contaminated when the compressor is purged of inhibiting oil.

5) Operate the unit in accordance with the overall installation requirements.

e) Start-Up After Long Term Inhibiting

To prepare the unit for operation after a long term period of inhibiting:

1) Remove compressor from storage container.

2) Remove all plugs from openings.

3) Remove the fourth stage cylinder head.

4) Remove the protective covering from the fourth stage piston.

5) Lubricate and reassemble the fourth stage piston, valve assembly and cylinder head. Tighten the head bolts.

6) Reconnect the compressor into the overall installation.

7) Refill the crankcase with the oil as recommended in the Technical Data Section 1.1. Inject 3 to 4 cc's of lubricating oil into the machine. Reassemble.

8) Remove all valve retainers and the air intake filter.

9) Turn the crankshaft by hand for a few revolutions.

10) Run the compressor off load for 15 minutes to circulate the oil.

CAUTION:

Take precautions to ensure that other equipment in the system is not contaminated when the compressor is purged of inhibiting oil.

11) Operate the unit in accordance with the overall installation requirements.

Section 3 - Operation

3.1 General

Before operating a compressor, ensure that it is properly installed and set-up as recommended in Section 2. The compressor should otherwise be operated in accordance with the overall system operating procedures.

It is particularly important to check that the moisture is drained from the compressor moisture separators every 20 to 30 minutes of running time.

Section 4 - Maintenance

4.1 GENERAL

Regular servicing in accordance with the recommendations given in this section is essential if compressor performance, reliability and safety are to be maintained at an optimum level. It is important to keep the compressor, safety devices, pipework and electrical equipment clean at all times. Regularly wipe away any oil films, dust and condensate which may collect on the compressor.

A daily general visual examination of the compressor coupled with a record of stage pressures will indicate possible impending malfunctions. The compressor log sheet located in Appendix 1 should be used to record all maintenance work. Periodic maintenance procedures detailed below are recommended as a general guide to routine servicing. As machines may be operated in different environments, the user should determine the most effective maintenance periods to suit each particular installation.

NOTE: Preventative maintenance can be effectively planned from the completed log sheet over a period of years.

4.2 ROUTINE MAINTENANCE PERIODS

a) DAILY

1) Check oil level in crankcase and top up if necessary. Maintain oil level at top of filler aperture, which is the maximum level. The danger level is when oil level is at bottom of dipstick. The combined oil level dipstick and filler plug unscrews from crankcase front cover.

2) Check operation of automatic unloader system, if fitted, or manually drain accumulated condensate by opening drain valve in base of each moisture separator. Amount of moisture collected and frequency of draining depends on relative air humidity and/or duty cycle of compressor. Amount of moisture in each separator should not be allowed to exceed 20cc before draining. Under normal circumstances, accumulated condensate should be drained after every 20 to 30 minutes of running time.

3) Visually check compressor, particularly for any signs of oil or air leaks.

4) Listen for any unusual noises during operation and investigate further if necessary.

5) Complete compressor log sheet as necessary.

b) EVERY 100 HOURS

1) Drain off lubricating oil immediately after a run whilst oil is still warm.

2) Clean magnetic drain plug and replace. Care should be taken to ensure that no metal particles are left in crankcase.

3) Refill crankcase with recommended grade of lubricating oil.

4) Remove air intake-filter and wash in detergent or as recommended by filter manufacturer. Thoroughly dry in a low-pressure warm air jet and replace.

5) Check all valve retainers for tightness.

6) Complete compressor log sheet as appropriate.

c) EVERY 200 HOURS

1) Carry out previous servicing procedures as described in Section 4.2.b.

2) Remove Stage 4 sintered bronze filter. Wash filter in white spirit or Chlorothene VG and dry with a low-pressure warm air jet. Examine filter seating and clean if necessary.

3) Reassemble spring onto sintered bronze filter and insert in banjo housing, ensuring that bonded seal is in good condition. Replace banjo cap.

4) Clean all outside surfaces of compressor to remove any traces of oil or dirt from heat radiating surfaces of cylinders and coolers.

5) Check all external fastenings and pipe fittings for tightness.

6) Check drive belts for wear and for correct tension as detailed in Section 2.4.

7) Complete compressor log sheet as necessary.

4.3 OVERHAUL 'A' TYPE - 800 HOURS RUNNING

Carry out previous servicing procedures and check valves as follows:

a) FIRST STAGE VALVES

Because of the nature of the combined first stage suction and delivery valve, careful cleaning only may be carried out. Individually worn reed valves or seats cannot be replaced, therefore the complete valve plate assembly must be replaced if necessary.

Scratches to valve seats and discs may be removed by careful hand lapping with two grades of valve grinding compound. To remove deep marks, use Carborundum Grade 360 FINE followed by lapping paste, Carborundum H500-OP. Minor surface marks may be removed using Carborundum H500-OP only.

Every trace of grinding and lapping compound must be removed before reassembly. The most effective method of cleaning is by use of an ultrasonic cleaner. Alternatively, thoroughly wash all parts in white spirit and dry with a low-pressure air jet.

To remove valve plate, refer to Section 4.4.a.

b) SECOND STAGE VALVES

NOTE: Always mark suction and delivery valves and pockets to facilitate correct reassembly.

1) Remove valves and examine parts for wear or damage.

2) Where only normal wear is observed, lightly lap valve seats using lapping paste Grade H500-OP, as described in Section 4.3.a.

3) If valves are observed to be deeply pitted, complete replacement will be necessary. The relatively low cost of a new valve makes servicing uneconomical.

4) If further wear is suspected, strip valves for examination. Refer to illustrations located in Section 6 for guidance.

5) To strip a second stage suction valve:

a) Fit a suitable Allen key in countersunk valve screw and remove split pin and valve nut.

b) Remove valve screw from valve seat.

c) Lift valve springs, valve plate and valve guard from screw.

d) Examine all parts for wear or damage and service accordingly.

e) To reassemble suction valve, place valve guard onto screw.

f) Replace valve springs on valve guard.

g) Locate valve plate and place valve seat over valve screw.

h) **ALWAYS** fit a new valve nut, ensuring that springs and plate are correctly aligned before tightening nut. Valve Nut Part No.Y27752.

NOTE: **DO NOT** reassemble using old valve nut.

6) To strip a second stage delivery valve:

a) Fit a suitable Allen key in countersunk valve screw and remove split pin and valve nut.

b) Lift off valve guard, valve springs and valve plate.

c) Examine all parts for wear or damage and service accordingly.

d) To reassemble, replace valve screw into valve seat.

e) Place interlocked springs on valve guard and valve disc onto springs.

f) Hold valve guard together with springs and disc and place onto valve screw.

g) **ALWAYS** fit a new valve nut, ensuring springs and plate are correctly aligned before tightening nut. Valve Nut Part No.Y27752.

NOTE: **DO NOT** reassemble using old valve nut

h) Before refitting reassembled valve, push valve plate away from seat to ensure freedom of movement and correct seating.

c) THIRD STAGE VALVES

Both valves are identical. Each valve consists of a seat and guard held together by a spring dowel and enclosing the valve springs and sealing disc. Particular care should be taken during reassembly as an incorrectly assembled valve could adversely affect the performance of the compressor.

DISMANTLING

1. Valves may be opened up by inserting a sharp blade or knife between seat and guard and gently easing apart.

2. Inspect valve seat and disc for signs of pitting and scratch marks. Examine springs for overheating and feathering at the edges.

3. Remove any carbon deposits carefully. Lap seats and discs as detailed in Section 4.3.a. and wash in white spirit. If any components are defective, complete valve must be replaced. Individual valve parts are not available.

ASSEMBLY

1. Place the springs over retaining spigot in valve guard.

2. Place valve disc on top of housing.

3. Align hole in seat with the spring pin and press firmly together.

d) FOURTH STAGE VALVES

1) Using a 5/16" Allen key, remove four socket cap screws retaining cylinder head.

2) Carefully remove cylinder head. Do not use a screwdriver or similar tool to lever off head. A light tap to side of head with a plastic-faced hammer is usually sufficient to break the seal. Collect delivery valve disc and spring as head is withdrawn.

3) Remove delivery valve seat allowing access to suction valve components.

4) Examine valve components for wear. If components are not badly worn, lightly lap valve plates and seats as described in Section 4.3.a. If components are not serviceable, replace entire valve assembly, but lap valve plates and seats as previously described.

5) Reassemble valves in reverse order to dismantling. Refer to exploded view given in Section 6 as a guidance to component positioning.

4.4 OVERHAUL 'B' TYPE - 1600 HOURS RUNNING

In addition to the previous checks, it is recommended that the compressor is completely overhauled after every 1600 hours of running. This major servicing procedure enables checks to be made with reference to the Schedule of Limits and Fits.

a) TO DISMANTLE 4S17 COMPRESSOR:

1) Stop compressor. Isolate motor from power and drain all pressure from system. Drain off lubricating oil whilst still warm. Remove filler plug to assist draining.

2) Remove fan flywheel retaining bolts and washers and withdraw flywheel.

3) Remove air intake assembly.

4) Disconnect all intercoolers, aftercooler and breather pipe connections. Plug all apertures to prevent ingress of dirt and foreign bodies.

5) Remove first stage cylinder head retaining screws. Remove cylinder head assembly including valve plate and gaskets.

NOTE: Note angular position of notch in side of valve plate to ensure correct reassembly.

6) Unscrew four socket screws and remove fourth stage cylinder head. Recover suction and delivery valve components.

7) Remove fourth stage cylinder complete with piston and liner.

8) Remove seven socket screws and withdraw crankcase front cover.

9) Bend up locking tabs and remove two screws and circular-retaining washer from end of crankshaft. Remove crankshaft balance weight.

10) Turn crankshaft by hand until low-pressure piston is at top dead centre.

11) Remove low-pressure cylinder base fastenings and partly withdraw cylinder. Note that low-pressure piston assembly is retained inside cylinder.

12) Move cylinder and piston assembly away from drive end of compressor and slide connecting rod big end off crankpin.

13) Carefully withdraw complete assembly, taking care to support piston assembly still located inside cylinder. Place on a clean surface for further dismantling.

14) Turn crankshaft by hand until high-pressure piston is at top dead centre.

15) Remove third stage cylinder base fastenings and partly withdraw cylinder. Note that third stage piston assembly is retained inside cylinder.

16) Move cylinder and piston assembly away from drive end of compressor and slide connecting rod big end off crankpin.

17) Carefully withdraw complete assembly, taking care to support piston assembly still located inside cylinder. Place on a clean surface for further dismantling.

18) Remove eight nuts and withdraw bearing assembly, taking care to support crankshaft as assembly is withdrawn.

b) BEARING HOUSING - DISMANTLING, SERVICING AND ASSEMBLY

With bearing housing assembly removed from crankcase, check for excessive play in crankshaft bearings. Check that crankshaft rotates freely without any signs of roughness. To inspect and renew bearings, proceed as follows:

1) Remove clamping collar from end of crankshaft.

2) Support bearing housing on large face and press out crankshaft. Larger bearing, inner sleeve and collar will come away with crankshaft.

3) Remove circlip-locating bearing from inside housing.

4) Support housing on large face and press out smaller bearing.

5) Press out oil seal.

6) Remove collar, sleeve and bearing from crankshaft.

7) Check both bearings for evidence of abrasive wear resulting in increased diametrical clearance or excessive looseness of bearing cage. Inspect ball tracks of larger bearing for pitting, corrosion or heat discolouration. Smaller bearing has sealing washers making inspection of tracks impossible. Both bearings must rotate freely without any signs of roughness. Bearing inspection is largely a matter of judgement and experience. If compressor has had extended use and is not expected to be stripped down again for a considerable time, it is recommended that new bearings should be fitted.

8) To reassemble, fit a new oil seal in outer end of housing. Press in seal with sealing lip towards inside of housing until outer face of seal is flush with outer face of housing. Care must be taken not to distort seal or damage sealing lip.

9) Support housing on small face and press in smaller bearing. Ensure bearing is pressed fully home in recess.

10) Fit bearing retaining circlip. Ensure circlip has expanded correctly into groove.

11) Press larger bearing fully onto crankshaft until seated against crankshaft web face. Fit inner sleeve and collar over crankshaft.

12) Support housing on small face. Enter crankshaft through smaller bearing and press larger bearing into housing.

IMPORTANT: When fitting crankshaft, **DO NOT** press against crankpin.

13) Inspect outside diameter of clamping collar. Collar must have a smooth ground finish to make a suitable track for housing seal.

14) Inspect 'O' ring fitted inside clamping collar and renew if necessary.

15) Slide clamping collar onto crankshaft and push against outer face of bearing.

c) FIRST AND SECOND STAGE PISTON AND CONNECTING ROD - DISMANTLING AND SERVICING

1) Withdraw piston and connecting rod assembly from top end of low-pressure cylinder.

2) Remove piston pin retaining circlips using circlip pliers.

3) Piston and pin are supplied as a matched pair. To remove pin, place piston in clean hot water at a temperature of 80°C to 85°C for 2 to 3 minutes. Water must just cover piston pin. Pin may then be pushed out with a wooden dowel. Under no circumstances should piston pin be drifted out cold as this will damage pin bores. Remove 'O' rings located in pin bores.

4) Remove piston rings. Label each ring to ensure refitting in correct grooves. Examine rings and ring grooves for wear. Refer to Schedule of Limits and Fits Table 4.1 for acceptable tolerances.

5) Wash all piston components thoroughly in solvent to remove all traces of dirt and oil deposits.

6) Check piston and pin bores for wear and replace as required. Refer to Schedule of Limits and Fits Table 4.1 for acceptable tolerances.

CAUTION: When fitting a new piston, carefully inspect all grooves and stepped diameters for sharp edges which may scuff cylinder bores. Remove with a fine stone if necessary.

6) Check connecting rod big and small ends for wear and surface finish. Renew as necessary. Replaced bearings must be fine bored to size after fitting.

d) THIRD AND FOURTH STAGE PISTON AND CONNECTING ROD - DISMANTLING AND SERVICING

Withdraw piston assembly from top end of third stage cylinder. Dismantle, service and assemble as described in Section 4.4.c.

e) FOURTH STAGE PISTON AND LINER

Fourth stage cylinder and piston will have been removed as previously described. The cylinder liner should not be removed during initial inspection. Recommended procedures are as follows:

1) Remove piston and check condition of piston rings. Rings should be replaced if there are indications of excessive wear, marked variations in radial thicknesses, pitting or grooves on rubbing faces. New rings should be expanded only the minimum amount necessary for fitting in order to avoid permanent distortion. Fitting may be facilitated by wrapping a thin shim around piston. Fit bottom piston ring first, then move shim upwards one groove at a time until all rings have been fitted.

NOTE: Prior to fitting **NEW** piston rings, check ring gaps by inserting each ring into cylinder bore. Ensure rings are square to bore and measure gaps with a feeler gauge. File piston ring butt ends if necessary to give a closed gap of:

Stage 4: 0.038 to 0.076 mm 0.0015" to 0.003"

2) Whether new rings are fitted or not, ensure that all rings are free in their grooves and all groove side faces are in good condition.

3) Visually check cylinder liner bore. Bore should be polished and free from blemishes or scratches. Examine fourth stage valve seat, which forms top part of liner. If any lapping of this seat is required, liner must be removed from cylinder.

4) To remove liner, push firmly from bottom of cylinder. Remove two sealing rings, one under liner top face and one from groove in cylinder bore. Lap valve seat as described in Section 4.3.1 and thoroughly clean all components.

5) New liner sealing rings must be fitted during reassembly. Push liner into cylinder bore. Lightly oil fourth stage piston and insert into liner from the underside.

f) PISTON AND CONNECTING ROD ASSEMBLIES

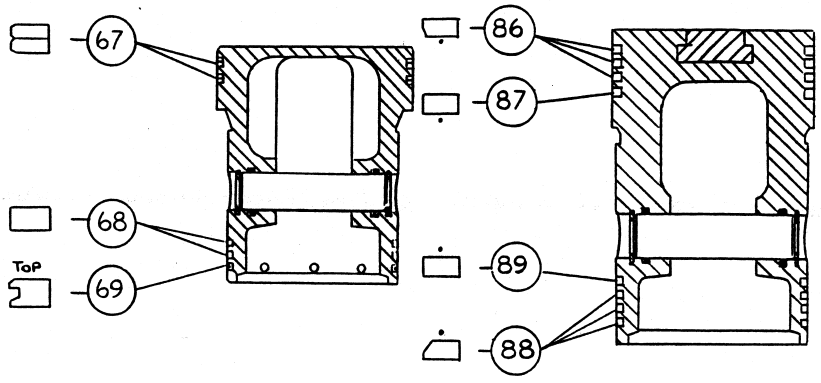
1) Place each piston in hot water at 80°C to 85°C for 2 to 3 minutes.

2) Whilst still hot, fit new 'O' ring seals in pin bores. Enter pin into boss, align connecting rod small end and push pin fully home.

3) Fit new circlips. Ensure circlips are fully expanded in their retaining grooves. Failure to do this could result in major and expensive damage to compressor.

4) Replace piston rings.

Prior to fitting **NEW** piston rings, check ring gaps by inserting each ring into correct cylinder bores. Ensure rings are square to bore and measure gaps with a feeler gauge. File piston ring butt ends if necessary to give a closed gap of:



Low Pressure Piston Third Stage Piston

NOTE: Item numbers are identified in Section 6.

Stage 1 & 2: 0.10 to 0.20 mm 0.004" to 0.008"

Stage 3: 0.05 to 0.15 mm 0.002" to 0.006"

Carefully assemble piston rings in their grooves as per diagram.

NOTE: It is important that ring faces identified with a dot or other manufacturer's mark are fitted as shown in the diagram above.

g) FIRST AND SECOND STAGE CYLINDER AND PISTON - REASSEMBLY

1) Lightly support cylinder in a vice. Ensure vice is not overtightened as this could distort cylinder bores.

2) Smear clean lubricating oil over piston. Stagger ring gaps around piston diameter and enter piston into top of cylinder.

3) Using fingertip pressure, press low pressure rings into grooves. Simultaneously, push piston into cylinder.

4) Any indication of obstruction will probably be due to second stage rings sliding out of their grooves. To overcome this difficulty, take a length of steel rod 3 mm in diameter and 200 mm long. Welding rod is ideal for this purpose. Bend one end 10 mm at right angles. Flatten this bent end with a hammer and file off all sharp edges. Other end of tool may be bent over to form a convenient handle.

5) Place bent end of this tool through valve ports in cylinder wall. With firm pressure, press second stage rings into their grooves. Simultaneously, push piston into cylinder.

6) Push piston down to bottom of cylinder. There should be no evidence of a gap between underside of first stage piston and step of cylinder when viewed through valve ports in cylinder wall.

h) THIRD STAGE CYLINDER AND PISTON - REASSEMBLY

Reassembly of third stage cylinder and piston is identical to the procedures described in Section g.

i) CRANKCASE AND CYLINDERS - REASSEMBLY

1) Smear boiled oil on a new bearing housing gasket. Position gasket and fit bearing housing onto crankcase. Tighten nuts to value given in Torque Loading Chart.

2) Smear boiled oil on a new third stage cylinder base gasket and fit over studs.

3) Pull third stage connecting rod and piston down to bottom of cylinder, guide connecting rod down into crankcase and slide big end onto crankshaft with connecting rod dipper pointing downwards.

4) Ensure correct angular position of cylinder and lower onto studs. Tighten nuts to value given in Torque Loading Chart.

5) Smear boiled oil on a new low-pressure cylinder base gasket and fit over studs.

6) Pull low-pressure connecting rod and piston down to the bottom of cylinder, guide connecting rod down into crankcase and slide big end onto crankshaft with connecting rod dipper pointing downwards.

7) Ensure correct angular position of cylinder and lower onto studs. Tighten nuts to value given in Torque Loading Chart.

8) Replace crankshaft balance weight and retaining washer. Use a new tab lock washer. Tighten retaining screws and bend up ends of tab washer to lock screws in position.

9) Smear boiled oil on a new front cover gasket. Position gasket on front cover and fit onto crankcase. Tighten screws to value given in Torque Loading Chart.

j) FOURTH STAGE CYLINDER AND VALVES - REASSEMBLY

1) Smear top face of third stage cylinder with Hermetite Silicone Sealant. Use sparingly and do not allow compound to run into cylinder bore.

2) Place fourth stage cylinder on a clean surface with suction valve seat facing upwards.

NOTE: Ensure piston is located in cylinder liner.

3) Place sealing ring in recess on suction valve seat. Note that suction valve seat is an integral part of fourth stage cylinder liner.

4) Invert fourth stage cylinder head and place delivery valve spring larger diameter into recess in cylinder head. Place recessed face of delivery valve disc onto spring. Place cylinder head on a clean surface ready for final assembly.

5) Take two of the four suction valve springs and interlock so that curved faces lie together. Similarly, interlock remaining two suction valve springs. Fit both sets of springs together with axis of curves at 90° as shown below and position springs into recess of delivery valve seat.

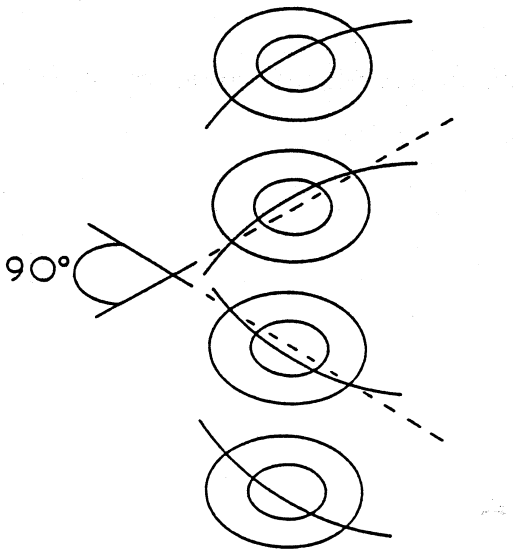


Diagram showing spring orientation

6) Place suction valve disc on top of springs. Hold valve disc and springs in place using either a 0.012"/0.015" feeler gauge or similar strip of plastic.

7) Place assembly directly over suction valve seat and whilst holding firmly, withdraw feeler gauge.

8) Ensure that delivery valve seat does not rock. Rocking will indicate that valve disc and springs are not positioned correctly.

9) With delivery valve seat held firmly in position, take cylinder head, complete with the delivery valve disc and spring, and slide carefully over delivery valve seat. Ensure

that cylinder head is correctly aligned and located firmly in position. Fit four retaining screws down through the head and cylinder.

10) With head and cylinder held firmly together firmly, place complete assembly in position on top of third stage cylinder. Tighten retaining screws evenly to figure given in Torque Loading Chart.

k) FIRST STAGE CYLINDER AND VALVE PLATE - REASSEMBLY

1) Ensure that first stage cylinder is fitted.

2) Place gasket in position on top face of cylinder.

3) Place reed valve plate assembly on cylinder with face marked 'Top' uppermost. Notch on side of valve plate should be to the right of second stage suction valve when viewed from above.

4) Place gasket on plate valve.

5) Fit cylinder head in position ensuring correct angular position. Tighten screws evenly to value given in Torque Loading Chart.

l) SECOND STAGE CYLINDER AND VALVES - REASSEMBLY

Suction and delivery valve housings differ in depth. Delivery valve must be fitted into deeper hole. Assembled valves cannot easily be distinguished from one another, therefore great care must be taken to ensure correct valve is fitted into correct housing. The housings are clearly marked 'S' and 'D' as appropriate to aid correct reassembly.

1) With reference to Figure 6.2, place valve seat washers into correct valve port recesses.

2) Place appropriate valve in position with nut facing outwards.

3) Fit new 'O' ring to each valve retainer. Fit valve retainer in pocket and tighten fasteners evenly to value given in Torque Loading Chart.

m) THIRD STAGE CYLINDER AND VALVES - REASSEMBLY

Suction and delivery valves are identical in appearance but differ slightly in dimensions, therefore great care should be taken to ensure correct valve is fitted into correct port.

1) With reference to Figure 6.2, place valve seat washers into valve port recesses.

2) Place appropriate valve into valve port on top of valve seat washer. Suction valve is located in port facing crankcase end cover and has single hole facing outwards. Delivery valve is located in port facing flywheel and has eight holes facing outwards.

3) Fit new 'O' ring to each valve retainer. Fit valve retainer in pocket and tighten fasteners evenly to value given in Torque Loading Chart.

n) FINAL ASSEMBLY

1) Replace intercooler coils, ensuring that all-union nuts and olives are secure. Do not distort coils and secure firmly to support brackets.

2) Fit fan/flywheel key. Replace flywheel and retaining washer. Tighten fasteners to value given in Torque Loading Chart and bend up tab washer to secure.

NOTE: Threads of retaining bolts should be lightly smeared with Loctite 241 to provide added security. Under no circumstances must any other Loctite adhesive be used.

3) Turn compressor by hand to ensure freedom of rotation and that fan is not being fouled by intercooler coils.

4) Replace compressor into system. Check drive belts for correct tension as detailed in Section 2.4.

5) Fill compressor with correct grade of oil as recommended in the Technical Data Section 1.

o) SAFETY VALVES

INTRODUCTION

Due consideration should be taken of climatic, process or other conditions which might adversely affect the performance of the safety valve. Installation must be undertaken by qualified technicians and to good engineering practice. In additions, user's attention is drawn to our joint responsibility to ensure that the Health and Safety at Work Act is not contravened by incorrect installation, commissioning or servicing. It is important that the valve to be installed is correct in every aspect, i.e. set pressure, size, material and type etc. for the application.

STORAGE OF VALVE BEFORE INSTALLATION

Valves should be stored preferably between 5°C and 25°C and a relative humidity of less than 75%. Very moist or very dry conditions should be avoided. If a safety valve is installed after six months, or more, of storage, it must be subjected to a functional test before commissioning.

Thread protectors should not be removed until immediately prior to testing or installation, as they also prevent the ingress of foreign matter which could harm the valve.

INSTALLATION - VALVE INLET

Under no circumstances should it be possible to isolate the safety valve from the protected system. Safety valves should be mounted as close as possible to the protected system. The connecting pipe should be straight and as short as possible. The inlet line to the safety valve should have an effective area of flow at least equal to that of the safety valve inlet. The manufacturer should be consulted if the safety valve is to be mounted in any position other than vertically. The maximum pressure drop through the inlet line to the safety valve should not exceed 3% of the set pressure when the valve is discharging at its rated capacity.

VALVE OUTLET

No isolating devices shall be fitted to the outlet pipe. Discharge pipes should be as short as possible and of such a size that the pressure developed therein will not reduce the relieving capacity. Ensure arrows indicating the direction of the flow are pointing in the correct direction. The cross-sectional area of the discharge pipe should not be less than the area of the safety valve outlet.

Where safety valves are discharged into a manifold, the manifold must be capable of accommodating simultaneous discharge of all valves connected to the manifold.

Atmospheric discharge or discharge pipes should terminate at a location which will not cause a hazard to personnel, particular attention being given to hazardous fluids or particles.

GENERAL

Inlet and outlet piping should be capable of supporting the safety valve so that no unacceptable mechanical load or vibration is transmitted to the valve and be sufficiently strong to withstand the effects of the reaction forces when the valve is discharging. All pipework or pressure vessels to which the safety valve is connected should be thoroughly cleaned before fitting the safety valve, to ensure that foreign matter does not pass through the valve. Particular care should be taken with the use of sealing compounds and P.T.F.E. tape to ensure that they do not enter the valve.

Atmospheric discharge valves should not be painted or coated with any substance which could possibly obstruct or restrict free and full discharge through the valve. Suitable protection should be provided to prevent environmental build up of ingress of foreign matter. Any condition that could lead to blockage of discharge piping or discharge ports on safety valves must be avoided. Where appropriate, discharge pipes should be provided to a non-hazardous location. Where there is a possibility of a liquid head forming in a discharge pipe, a drain should be provided which leads to a safe discharge location. To prevent unnecessary lifting of the safety valve it is recommended that there is a margin of at least 10% between the maximum operating pressure and the set pressure of the safety valve.

FUNCTIONAL TESTING

Once installed in service, valves should be tested at least once every six months to ensure free movement of parts. This should be carried out by operating the easing gear when the valve is under a pressure of not less than 75% of the set pressure. Where valves are supplied without easing gear, the test should be in accordance with the full functional test described below. Due regard must be paid to the safety of personnel. Testing should not create a hazard, particular attention being given to foreign matter located in discharge outlets.

When valves are installed in extreme operating environments, as listed below, the frequency of testing must be increased.

a) Hot, dry, dusty or high humidity areas.

b) Oil, tar or gumming deposits.

c) Sand, grit, earth, cements (construction, quarry or similar sites).

d) Pollution laden atmosphere (chemical works).

e) Any area where the valve can become contaminated with foreign matter likely to obstruct free and full discharge through the valve.

THE FREQUENCY OF TEST MUST BE ESTABLISHED BY THE USER TO SUIT EACH INSTALLATION OR PROCESS. IT IS IMPORTANT THAT DISCHARGE OUTLETS OF THE SAFETY VALVE BE KEPT IN A CLEAN CONDITION, FREE FROM DEPOSITS OR BUILD OF FOREIGN MATTER.

FULL FUNCTIONAL TEST

Safety valves should be checked every 12 months for correct function and test of set pressure, full flow and reseat pressures. Ideally the valve should be removed from the system and tested on specific test equipment. Before dismantling any pressurised components, the system must be effectively isolated from all sources of pressure and completely vented to atmosphere. When safety valves are taken out of service, care must be taken that the plant remains secure. Parallel or replacement safety devices of at least the same capacity must be provided. Where a safety valve does not meet the specification it must be refurbished, or replaced. If the valve is not functioning correctly, ie. noisy or 'hammering' refer to the manufacturer.

IT IS RECOMMENDED THAT ADJUSTMENTS, MAINTENANCE AND REPAIR OF SAFETY VALVES, INCLUDING CHANGES IN SET PRESSURE, SHOULD ONLY BE PERFORMED BY THE MANUFACTURER OR AN AUTHORISED REPRESENTATIVE.

Table 4.1 – Schedule Of Limits And Fits

Component	Design Size Inches (mm)	Wear Limit	Total Clearance (Maximum)
Crankcase			
Crankpin	1.3776/1.3772 (34.991/34.980)	1.376 (34.95)	0.004 (0.10)
Big end bearing (fitted)	1.3786/1.3780 (35.016/35.000)	1.381 (35.08)	
Piston pin diameter	0.5906/0.5902 (15.000/14.992)	0.5898 (14.980)	0.002 (0.05)
Small end bearing (fitted)	0.5910/0.5908 (15.011/15.006)	0.593 (15.06)	
Low Pressure Piston			
Piston major diameter	3.495/3.494 (88.78/88.75)	3.492 (88.70)	0.012 (0.30)
Cylinder diameter	3.501/3.500 (88.93/88.90)	3.504 (89.00)	
Major dia comp ring (axial thickness)	0.1250/0.1245 (3.18/3.16)	0.1225 (3.11)	0.005 (0.13)
Major dia comp ring (groove width)	0.1264/0.1256 (3.21/3.19)	0.128 (3.25)	
Major dia comp ring (radial thickness)	0.125/0.117 (3.18/2.97)		0.020 (0.5) Ring gap in cylinder
Piston minor diameter	3.066/3.065 (77.88/77.85)	3.063 (77.80)	0.012 (0.30)
Cylinder diameter	3.072/3.071 (78.03/78.00)	3.075 (78.11)	

Component	Design Size Inches (mm)	Wear Limit	Total Clearance (Maximum)
Minor dia comp ring (axial thickness)	0.062/0.0615 (1.575/1.563)	0.0605 (1.54)	0.005 (0.13)
Minor dia comp ring (groove width)	0.0634/0.0626 (1.61/1.59)	0.065 (1.65)	
Minor dia comp ring (radial thickness)	0.125/0.119 (3.18/3.02)		0.020 (0.5) Ring in gap cylinder
Minor dia oil control ring (axial thickness)	0.1244/0.1239 (3.160/3.148)	0.122 (3.10)	0.005 (0.13)
Minor dia oil control ring (groove width)	0.1264/0.1256 (3.21/3.19)	0.128 (3.25)	
Minor dia oil control ring (radial thickness)	0.1252/0.1189 (3.18/3.02)		0.020 (0.5) Ring in gap cylinder
3rd Stage Piston			
Piston major dia	2.574/2.573 (65.378/65.352)	2.571 (65.30)	0.009 (0.23)
Cylinder diameter	2.580/2.579 (65.53/65.50)	2.582 (65.58)	
Major dia comp ring (axial thickness)	0.1244/0.1240 (3.160/3.148)	0.122 (3.10)	
Major dia comp ring (groove width)	0.1264/0.1256 (3.21/3.19)	0.128 (3.25)	
Major dia comp ring (radial thickness)	0.113/0.107 (2.88/2.72)		0.020 (0.5) Ring gap in cylinder

Component	Design Size Inches (mm)	Wear Limit	Total Clearance (Maximum)
Piston minor dia	2.458/2.457 (62.439/62.413)	2.455 (62.36)	0.007 (0.18)
Cylinder diameter	2.462/2.461 (62.53/62.50)	2.464 (62.59)	
Minor dia comp ring (axial thickness)	0.0783/0.0779 (1.990/1.978)	0.076 (1.93)	
Minor dia comp ring (groove width)	0.0803/0.0795 (2.04/2.02)	0.082 (2.08)	
Minor dia comp ring (radial thickness)	0.109/0.103 (2.78/2.62)		0.020 (0.5) Ring in gap cylinder
Final Stage Piston			
Piston diameter (below rings)	0.4980/0.4976 (12.65/12.64)	0.4960 (12.60)	0.005 (0.13)
Cylinder liner	0.4988/0.4984 (12.67/12.66)	0.4990 (12.675)	
Compression ring (radial thickness)	0.0625/0.0620 (1.588/1.575)	0.0605 (1.537)	0.005 (0.13)
Compression ring (groove width)	0.0644/0.0634 (1.635/1.610)	0.0660 (1.676)	
Compression ring (radial thickness)	0.0270/0.0210 (0.686/0.533)		0.010 (0.25) Ring gap in cylinder

NOTE:

Maximum clearance can be obtained before either of the mating parts has reached the wear limit but either one or both parts should be replaced as soon as the maximum clearance given in the above is table is reached.

Table 4.2 – Torque Loading Chart

Size	Description	Torque	
		Lbf/ft	Kgf.m
M10	Cylinder head screws	14/16	2.0/2.2
M10	Cylinder base nuts	14/16	2.0/2.2
M8	Bearing housing nuts	10/12	1.4/1.7
M8	Crankcase end cover screws	8/10	1.1/1.4
M8	Fan blade retainer screws	8/10	1.1/1.4
M6	Crankpin screws	7/9	1.0/1.3
M6	Crankshaft drive pulley screws	7/9	1.0/1.3
1 ¼" UNF	Valve holders	30/32	4.1/4.4

NOTE:

The above torque figures are for specific applications and must be strictly adhered to. If the threads are lubricated, the nuts and bolts which are tightened to the recommended torque figures will be in danger of stripping their threads, so before assembly, wipe the threads with a clean rag.

The following list is recommended for general use on unspecified bolts and nuts.

Thread	Lbf/ft	Kgf.m
M5	2.5/3.5	0.35/0.48
M6	4.5/6.5	0.62/0.90
M8	8/10	1.1/1.4
M10	14/16	2.0/2.2

Section 5 – Fault Diagnosis

5.1 General

The technical description given in this handbook should enable an experienced technician to trace any fault to a suspect area and further investigations should pinpoint the fault. Table 5.1 lists fault symptoms which may arise after long and arduous operations, their possible causes and recommended remedies. See Section 4 for dismantling and reassembling instructions.

Table 5.1 – Fault Finding

Symptoms	Possible Fault	Remarks
1. Low output without interstage safety valves blowing	a) Filter blocked b) Loose belts c) Air leaks d) Worn valves	a) Check air filter for blockage b) Check main drive belts c) Check for external air leaks d) Check 1st stage valves
2. Low output with 1st stage safety valve blowing	a) Dirt between 2nd stage valve seat, broken or worn springs or chipped valve disc	a) Examine the 2nd stage suction and delivery valves and maintain as necessary
3. Low output with 2nd stage safety valve blowing	a) Dirt between 3rd stage valve seat, broken or worn springs or chipped valve disc	a) Examine the 3rd stage suction and delivery valves and maintain as necessary
4. Low output with 3rd stage safety valve blowing	a) Dirt between final stage valve discs and seat, broken or worn springs or chipped valve disc	a) Examine the final stage suction and delivery valves and maintain as necessary
5. Low output persists with possible high oil consumption and crankcase pressure	a) Suspect cylinder wear, broken piston rings	a) Dismantle and check as recommended in the Overhaul 'B' procedure
6. Cylinder overheating	a) Delivery valve leaking, causing recompression b) Intercooling pipes coated with dirt c) Incorrect rotation	a) Check and maintain necessary b) Clean intercooling pipes c) Stop immediately and check for correct location
7. General overheating and overloading of prime mover	a) Oil starvation b) Restricted cooling to unit c) Low compression speed	a) Check oil level b) Check intercooling pipes c) Check drive belts
8. Continuous blowing of safety valves	a) Faulty safety valve	a) Remove safety valve and replace

Section 6 – Spare Parts

6.1 Introduction

Spare parts for the compressor may be obtained from:

Eagle Compressors, Inc.
Spare Parts department
Pleasant Garden
North Carolina
USA

Telephone 336-674-3621

Fax 336-674-7672

E-mail: eagleair@eaglecompressors.com

When ordering spare parts, please give the following information:

1. Name, model number and serial number of the compressor. Note that the serial number is stamped on the metal plate attached to the crankcase.

2. Description of part required.

3. Part number of part required.

4. Quantity of parts required.

5. Ordering department's name and full postal address.

The following tables list the components parts of the compressor, which are also illustrated where possible on the associated exploded views.

Figure 6.1 – Compressor exploded view

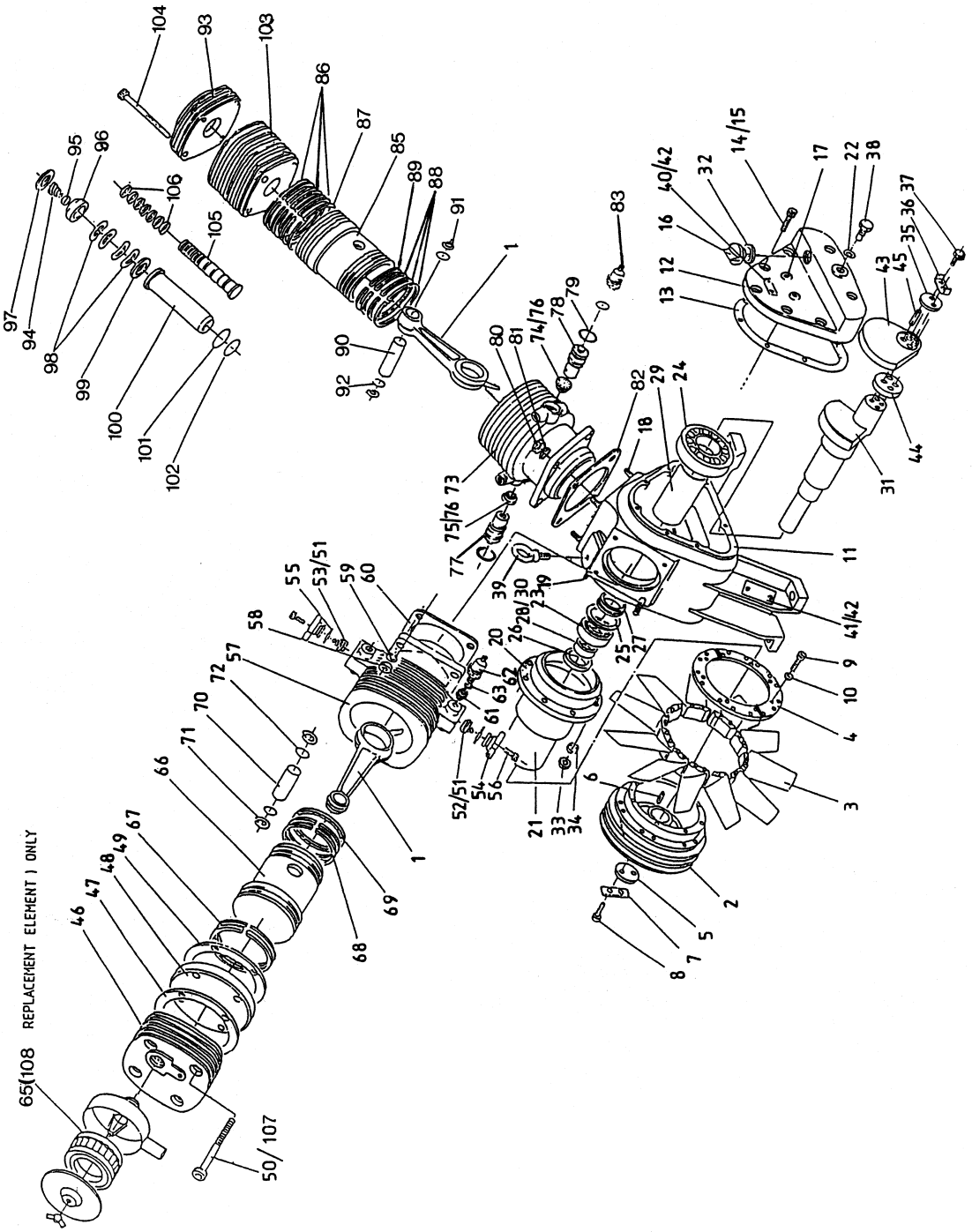


Table 6.1 – Compressor Parts List

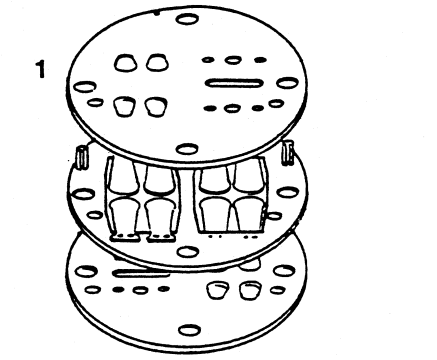
ITEM	PART NO	DESCRIPTION	QTY
1	70-25006	CONNECTING ROD	2
1	Y28083	CONNECTING ROD SMALL END BUSH	2
1	Y25008	BIG END BUSH - SPECIAL	2
1	Y28082	CONNECTING ROD C/W BUSHES	1
2	Y25011	MACHINED FLYWHEEL	1
3	Y25012	FAN BLADE MULTI-WING R.H. 35 DEG X 106 MM BLADE	11
4	Y25013	BLADE RETAINER	2
5	Y25014	RETAINING WASHER	1
6	Y25015	FLYWHEEL KEY	1
7	Y25016	TAB WASHER	1
8	Y24565/20	M6 X 20MM HEX HEAD SETSCREW HIGH TENSILE	2
9	Y24602/25	M8 X 25MM SOCKET CAPSCREW	6
10	MSWS/8	SPRING WASHER 8M STAINLESS.	6
11	Y25101	CRANKCASE	1
12	Y25014	RETAINING WASHER	1
13	Y25017	CRANKCASE END COVER GASKET	1
14	Y24602/25	M8 X 25MM SOCKET CAPSCREW	5
15	Y24602/80	M8 X 80MM SOCKET CAPSCREW	2
16	Y08085	OIL FILLER CAP	1
17	Y17329	1/4 BSP TAPER PRESSURE PLUG	4
18	Y24579/35	M10 X 35MM STUD	8
19	Y20478/35	M8 X 35MM STUD	8
20	Y25019	BEARING HOUSING GASKET	1
21	Y25020	BEARING HOUSING	1
22	10001/9	BONDED SEAL 1/4"BSP	1
23	Y25022	BEARING	1
24	Y25023	BEARING	1
25	Y25024	CIRCLIP 72	1
26	Y25025	OIL SEAL 42 X 62 X 8MM.	1

ITEM	PART NO	DESCRIPTION	QTY
27	Y25026	BEARING SPACER	1
28	Y25027	CLAMPING COLLAR	1
29	Y25063	BEARING SPACER	1
30	Y25064	O RING 33	1
31	Y29262	CRANKSHAFT	1
32	Y24364	O RING 3/4"X 3/32"	1
33	Y24626	REPLACED BY MCN8Z HEX HEAD NUT	8
34	MSWS/8	SPRING WASHER 8M STAINLESS.	8
35	Y36835	RETAINING WASHER.	1
36	Y25016	TAB WASHER	1
37	Y24553/30	M6 X 30MM HEX HEAD BOLT HIGH TENSILE.	2
38	Y22155	SUMP PLUG SUB-ASSEMBLY	1
39	Y27875	EYEBOLT M10 X 25	1
40	Y13253	PLATE - DIRECTION ARROW 32 X 9 X 0.7 AL	
41	Y21941	NAMEPLATE - MODEL & SER.NO. 58 X 26 X 0.7 AL	1
42	Y09926	SCREW DRIVE SIZE O	4
43	Y29263	BALANCE WEIGHT	1
44	Y29264	CRANKPIN COLLAR	1
45	Y29265	DOWEL 8	2
46	Y37692	L.P CYLINDER HEAD	1
47	Y25031	CYL HEAD/VALVE GASKET	1
48	Y37636	REED VALVE ASSEMBLY.	1
49	Y35334	CYLINDER/VALVE GASKET	1
50	Y20503/70	M10 X 70MM SOCKET CAPSCREW	2
51	Y25547	VALVE SEAT WASHER	2
52	Y25548	SUCTION VALVE ASSEMBLY TYPE - 30R	1
53	Y25549	DELIVERY VALVE ASSEMBLY -TYPE 30R	1
54	Y25627	VALVE CAGE 2ND STAGE	2
55	Y30378	O RING 37	2
56	Y24601/16	M6 X 16MM SOCKET CAPSCREW	8
57	Y36364	CYLINDER LP	1
58	MCN10Z	HEX HEAD NUT	4

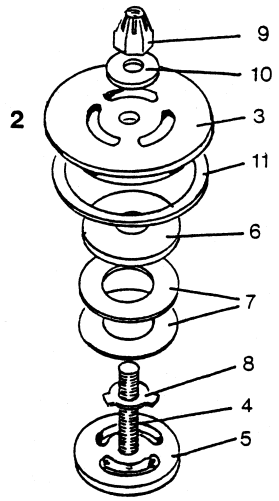
ITEM	PART NO	DESCRIPTION	QTY
59	Y24691	M10 SPRING WASHER ZN.PL.& PASS.	4
60	Y35333	CYLINDER BASE GASKET	1
61	Y27819	ADAPTOR 1/2"BSP X 1/4"BSPF X 3/8"TH.	1
62	Y20899	SAFETY VALVE 1/4"BSP 150 PSI.	1
63	10001/9	BONDED SEAL 1/4"BSP	2
64	Y11743	WASHER	1
65	Y37670	AIR INTAKE FILTER	1
66	Y37638	L.P PISTON SUB ASSY	1
67	Y08082	COMPRESSION RING.	2
68	Y25121	COMPRESSION RING	2
69	Y35352	STANDARD OIL CONTROL RING 078. TOP OF RING TO BE	1
70	Y36381	GUDGEON PIN	1
71	82017	CIRCLIP	2
72	Y25117	O RING 19/32"X 3/32"	2
73	Y25306	3RD STAGE CYLINDER	1
74	Y25307	SUCTION/DELIVERY VALVE 14C	1
75	Y25308	DELIVERY VLVE -14C.	1
76	Y25309	VALVE SEAT WASHER	2
77	Y25321	VALVE RETAINER	1
78	Y38910	ST.3.INLET VALVE RETAINER	1
79	Y25069	O RING 27	2
80	MCN10Z	HEX HEAD NUT	4
81	Y24691	M10 SPRING WASHER ZN.PL.& PASS.	4
82	Y25061	CYLINDER BASE GASKET	1
83	Y23182	SAFETY VALVE 1/4"BSP 650 PSI	1
84	Y23700	SAFETY VALVE 1/4"BSP 1400 PSI	1
85	Y27856	3RD STAGE PISTON SUB ASSEMBLY.	1
86	Y38039	PISTON RING	3
87	Y25312	COMPRESSION RING	1
88	Y38040	PISTON RING	3
89	Y25313	COMPRESSION RING	1
90	Y25315	GUDGEON PIN	1

ITEM	PART NO	DESCRIPTION	QTY
91	82017	CIRCLIP	2
92	Y25117	O RING 19/32"X 3/32"	2
93	Y25302	HP CYLINDER HEAD	1
94	Y16411	DELIVERY VALVE SPRING	1
95	Y16413	DELIVERY VALVE DISC TYPE 12A	1
96	Y34606	DELIVERY VALVE SEAT	1
97	Y25045	SEAL	1
98	Y16415	SUC VALVE SPRING	4
99	Y16414	SUCTION VALVE PLATE	1
100	Y35139	CYLINDER LINER	1
101	Y25047	O RING 32	1
102	MR0221-16F	O RING	1
103	Y25050	H.P. CYLINDER	1
104	Y20503/135	M10 X 135 SOCKET CAPSCREW	4
105	Y35138	PISTON 4TH STAGE.	1
106	Y35140	PISTON RING - 4TH STAGE	7
107	Y24603/75	M10 X 75MM LG SOCKET CAPSCREW	2
108	Y22455	FILTER ELEMENT C/W GUARD	1

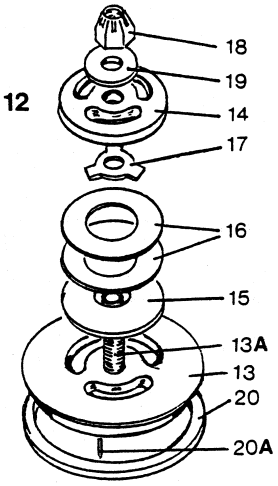
Figure 6.2 – 4S17 Valve Assemblies



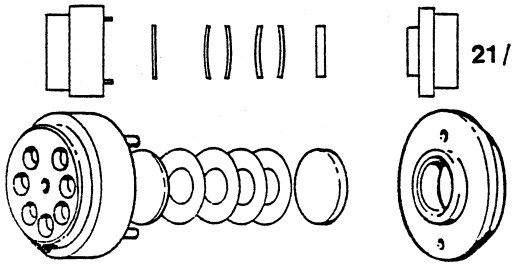
1st Stage Suction & Delivery Reed Valve Assembly



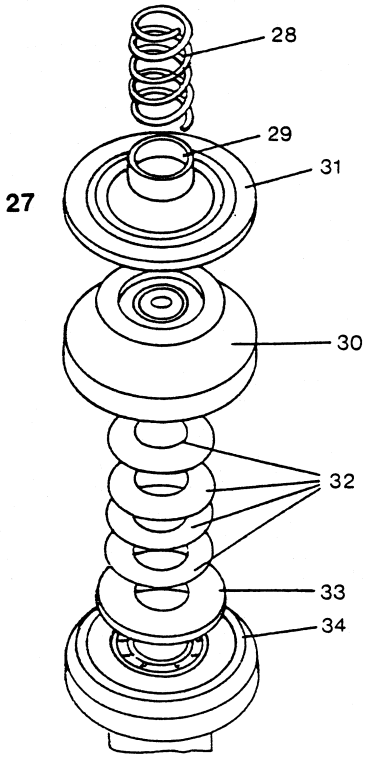
2nd Stage Suction Valve Assembly



2nd Stage Delivery Valve Assembly



3rd Stage Suction & Delivery Valve Assembly No. 25307/8 14C



4th Stage Suction & Delivery Valve

Table 6.2 – Valve Assemblies Parts List

ITEM	PART NO	DESCRIPTION	QTY
1	Y37636	1ST STAGE SUCTION AND DELIVERY REED VALVE ASSEMBLY	1
2	Y25548	2ND STAGE SUCTION VALVE COMPRISING:	1
3		SEAT	1
4		CENTRE BOLT	1
5		BUFFER PLATE	1
6		VALVE RING	1
7		SPRING	2
8		GUIDE RING	1
9	Y36366	NUT	1
10	Y36365	WASHER	1
11	Y2554	VALVE SEAT WASHER	1
12	Y25549	2ND STAGE DELIVERY VALVE COMPRISING:	1
13		SEAT	1
13A		CENTRE BOLT	1
14		BUFFER PLATE	1
15		VALVE SPRING	2
16		SPRING	1
17		GUIDE RING	1
18	Y36366	NUT	1
19	Y36365	WASHER	1

ITEM	PART NO	DESCRIPTION	QTY
20	Y25547	VALVE SEAT WASHER	1
20A		DOWEL PIN	1
21	Y25307	3RD STAGE SUCTION VALVE COMPRISING:	1
22		SPRING	4
23		DISC	1
24	Y25308	3RD STAGE DELIVERY VALVE COMPRISING:	1
25		SPRING	4
26		DISC	1
27		4TH STAGE SUCTION AND DELIVERY VALVES COMPRISING:	
28	Y16411	DELIVERY VALVE SPRING	1
29	Y16413	DELIVERY VALVE SPRING	1
30	Y34606	DELIVERY VALVE SEAT	1
31	Y25045	DELIVERY VALVE SEAT GASKET	1
32	Y16415	SUCTION VALVES SPRING	4
33	Y16414	SUCTION VALVE DISC	1
34	Y35139	CYLINDER LINER	1

Figure 6.3 – 4S17 Cooling System

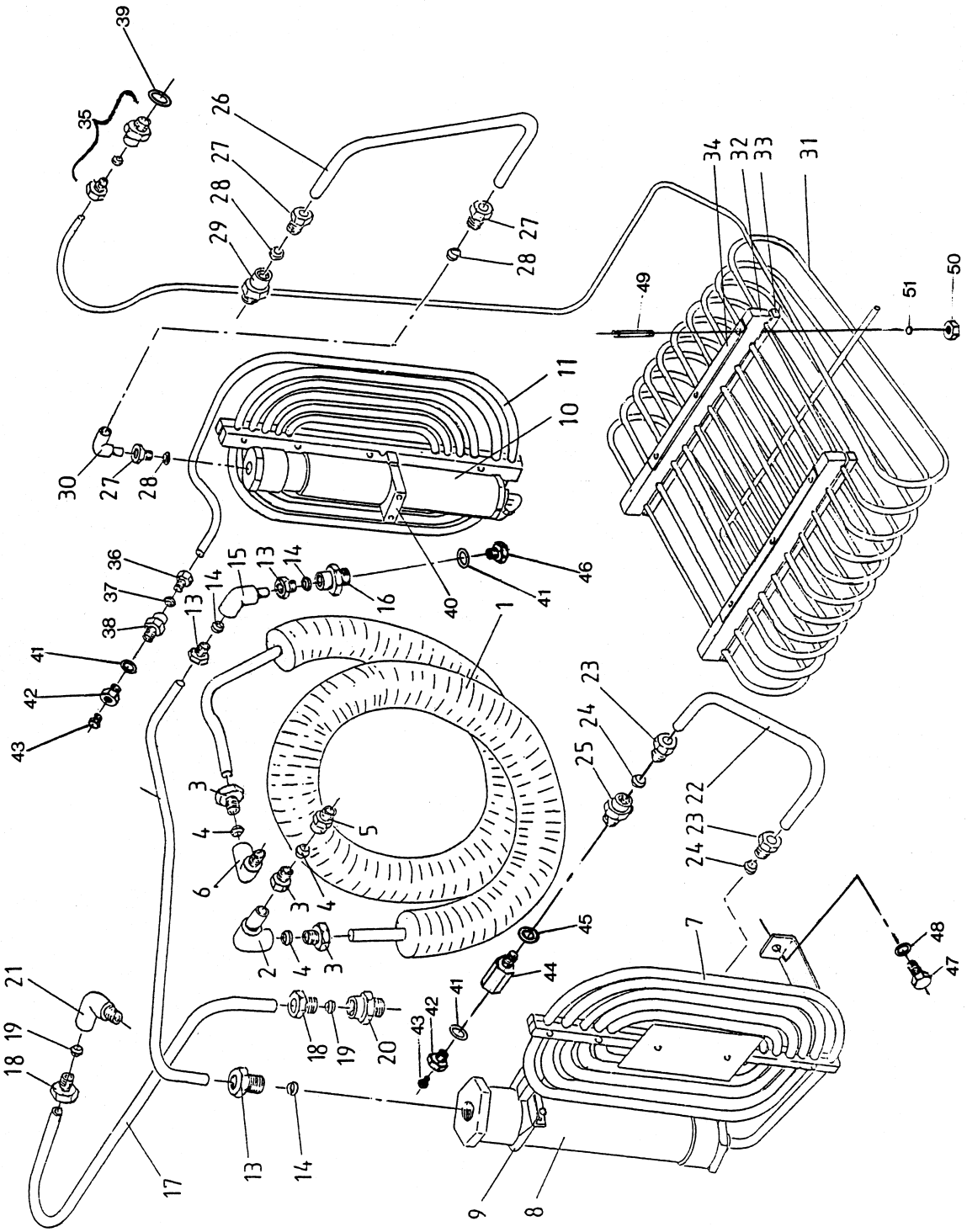


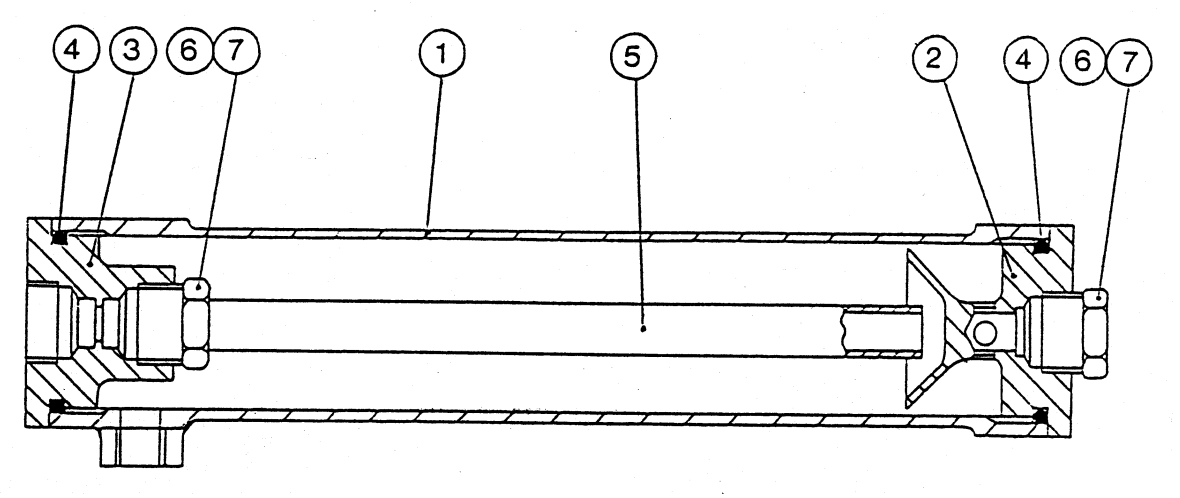
Table 6.3 – Cooling System Parts List

ITEM	PART NO	DESCRIPTION	QTY
1	Y37679	COOLER COIL 1ST STAGE	1
2	Y35063	STEM ELBOW ½" BSP x 5/8" P	1
3	Y14302	TUBING NUT 5/8"	3
4	Y14303	TUBING SLEEVE 5/8"	3
5	Y09557	MALE ADAPTOR ½" BSPT x 5/8" P	1
6	Y09623	MALE ELBOW ½" BSP x 5/8" P	1
7	Y37681	INTERCOOLER – 2ND STAGE TO 3RD STAGE	1
8	Y21521	MOISTURE SEPARATOR	1
9	Y16401	CLAMP	1
10	Y21523	MOISTURE SEPARATOR	1
11	Y27868	INTERCOOLER – 3RD STAGE TO 4TH STAGE	1
12	Y37687	INLET PIPE – 3RD STAGE	1
13	Y14300	TUBING NUT ½"	3
14	Y14301	TUBING SLEEVE ½"	3
15	Y18599	STEM ELBOW ½" x ½"	1
16	Y09550	MALE ADAPTOR ¼" BSPT x ½" T	1
17	9623/1/03	PIPE 3/8" O/DIA	1
18	Y14298	TUBING NUT 3/8"	2
19	Y14299	TUBING SLEEVE 3/8"	2
20	Y09547	OIL FEED ADAPTOR ASSEMBLY	1
21	Y25118/1	OIL FEED ELBOW ASSEMBLY	1

ITEM	PART NO	DESCRIPTION	QTY
22	Y37685	DELIVERY PIPE – 2ND STAGE	1
23	Y14300	TUBING NUT ½”	2
24	Y14301	TUBING SLEEVE ½”	2
25	Y09552	MALE ADAPTOR ½” x BSPT x ½” T	1
26	Y35412	DELIVERY PIPE	1
27	Y14298	TUBING NUT 3/8”	3
28	Y14299	TUBING SLEEVE 3/8”	3
29	Y09547	MALE ADAPTOR ¼” BSPT x 3/8” T	1
30	Y18600	STEM ELBOW CONNECTOR 3/8” T	1
31	Y37688	AFTERCOOLER COIL	1
32	Y37689	CLAMPING STRIP	2
33	Y37690	SUPPORT STRIP	2
34	Y25217	INSULATION STRIP	2
35	Y24398	STRAIGHT COUPLING ¼” T	1
36	Y14298	TUBING NUT 3/8”	1
37	Y14299	TUBING SLEEVE 3/8”	1
38	Y09547	MALE ADAPTOR ¼” BSPT x 3/8” T	1
39	Y23113	SEALING WASHER	1
40	Y25213	CLAMP	1
41	Y17969	BONDED SEAL ¼” BSP	3
42	Y23844	MALE ADAPTOR ¼” BSP – 4mm T	2
43	Y29329	STOPPING PLUG 4mm	2
44	Y27819	RED BUSH ½” – ¼” BSP	1

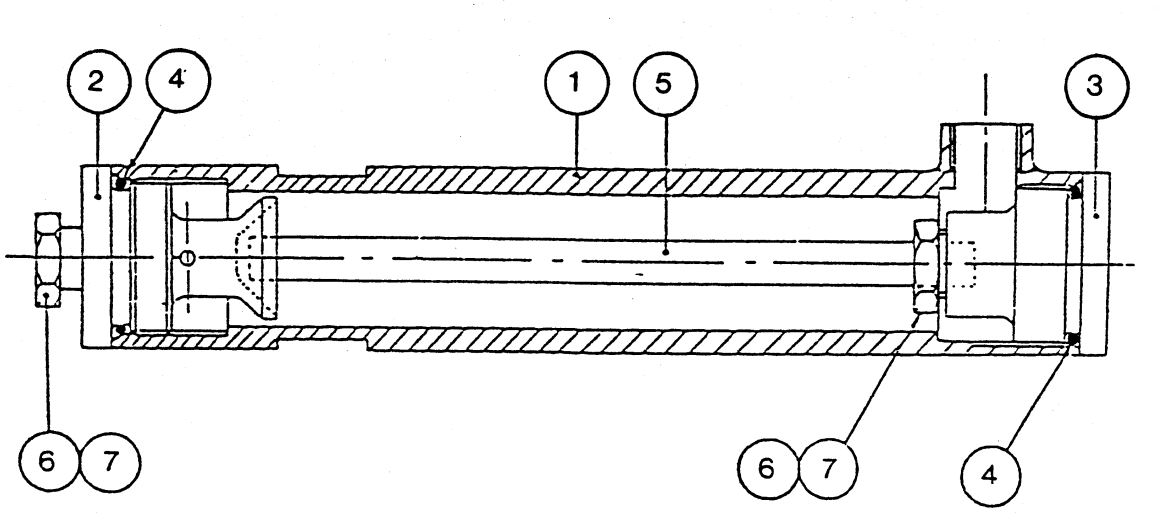
ITEM	PART NO	DESCRIPTION	QTY
45	Y11743	FOLDED COPPER WASH ½" BSP	1
46	Y37294/1	PLUG ¼" BSP	1
47	Y24566/12	SETSCREW M8 x 12mm LONG	1
48	Y24690	SPRING WASHER M8	1
49	Y24577/55	STUD M6 x 55 LONG	6
50	Y24625	NUT M6	6
51	Y24689	SPRING WASHER M6	6
52	Y28894	PIPE CLIP ¼" DIA	1
53	Y20500/12	CAPSCREW M5 x 12mm	1

Table 6.4 - 2nd Stage Moisture Separator Assembly



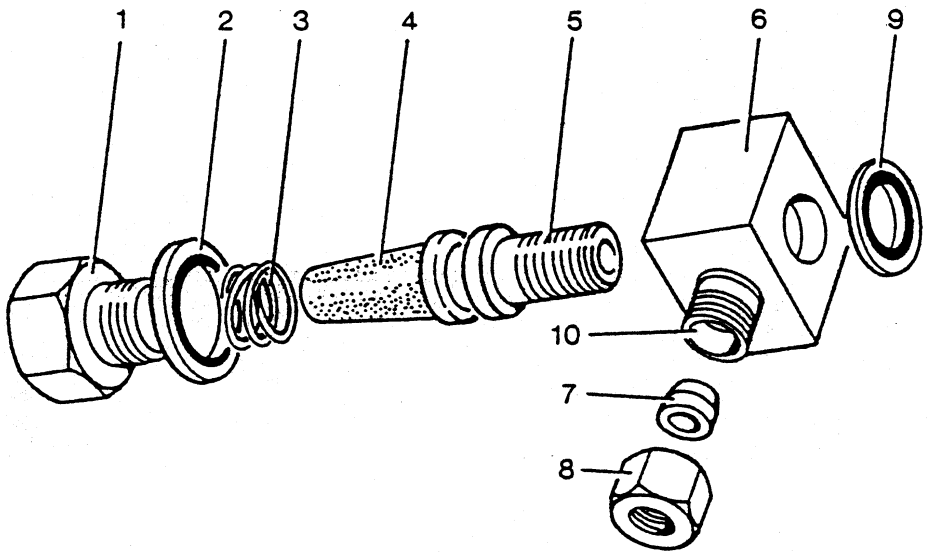
ITEM	PART NO	DESCRIPTION	QTY
1	Y22208	BODY	1
2	Y22209	END CAP/DEFLECTOR	1
3	Y22210	END CAP	1
4	Y27637	'O' RING SEAL	2
5	Y18603/66	TUBE ½" O/DIA	1
6	Y14300	TUBING NUT ½"	2
7	Y14301	TUBING SLEEVE ½"	2

Table 6.5 – 3rd Stage Moisture Separator Assembly



ITEM	PART NO	DESCRIPTION	QTY
1	Y22178	BODY	1
2	Y22179	END CAP/DEFLECTOR	1
3	Y22180	END CAP	1
4	Y22181	'O' RING SEAL B.S.214	2
5	Y22017/152	TUBE (3/8" O/D x 16 SWG CU)	1
6	Y14298	TUBING NUT 3/8" PIPE	2
7	Y14299	TUBING SLEEVE 3/8" PIPE	2

Table 6.6 – Inline Filter Assembly



ITEM	PART NO	DESCRIPTION	QTY
	Y23553	INLINE FILTER ASSEMBLY COMPRISING:	1
1	Y23496	BANJO CAP	1
2	Y23985	BONDED WASHER 18mm	1
3	Y23498	SPRING	1
4	Y17817	FILTER	1
5	Y23497	RETAINING SCREW	1
6	Y23495	SPECIAL BANJO	1
7	Y14299	TUBING SLEEVE	1
8	Y14298	TUBING NUT	1
9	Y17969	BONDED ¼" BSP	4
10	Y09547	ADAPTOR	1

Appendix 1 – Compressor Log Sheet

Compression	Prime Mover	Installed At	Oil Grade Used
Type	Type		
Speed	B.H.P		
Serial No.	Drive	Date Installed	

Date	Time	Hours Run	Room Temp.	Stage Pressures				Oil Level	Filter Checked	Signature
				1	2	3	4			

Appendix 1 – Compressor Log Sheet

Compression	Prime Mover	Installed At	Oil Grade Used
Type	Type		
Speed	B.H.P		
Serial No.	Drive	Date Installed	

Date	Time	Hours Run	Room Temp.	Stage Pressures				Oil Level	Filter Checked	Signature
				1	2	3	4			